Water Quality Curriculum Development

Taylor Hamblin, University of Nebraska-Lincoln PhD candidate, manager of the Citizenship - Water Quality Curriculum Project, and editor of *Protecting Nebraska Waters*.

Taylor Hamblin, M. A.

- Licensed educator since 2012. Six years in secondary classrooms: history, civics, Spanish
- Instructs social studies methods and supervises field placements at University of Nebraska-Lincoln
- Researches civic engagement, interdisciplinary learning, and inquiry-based learning. Ph.D. defense in June 2023.
- Manages the Citizenship - Water Quality Curriculum Project and edits *Protecting Nebraska Waters*
- UNL web page and personal website

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National Geographic and UNMC Grants

- The idea for the project came from a conversation.
- Applied for and received the Nebraska Geography Education Funding Program Grant and a grant from University of Nebraska Medical Center.
- Received funding in October 2020, but the actual work did not begin until the summer of 2021.
- Work will continue into summer 2023 with curriculum revisions and additions.

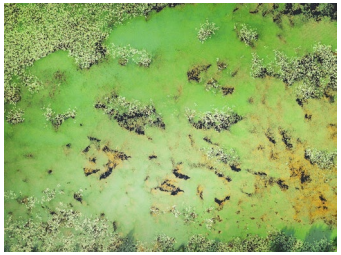
Why might we develop middle school and high school curriculum and train teachers to focus on water quality and citizenship skills?

The Importance of Water to Nebraska and The Midwest


I'm an
avid
scuba
diver

Concerning Issues Facing Water Quality?

Excess Nutrients (Kellogg, 2021)



Pesticide in Groundwater (Ferguson, 2015)

Contaminants in Surface Water (Kirsch, 2020)

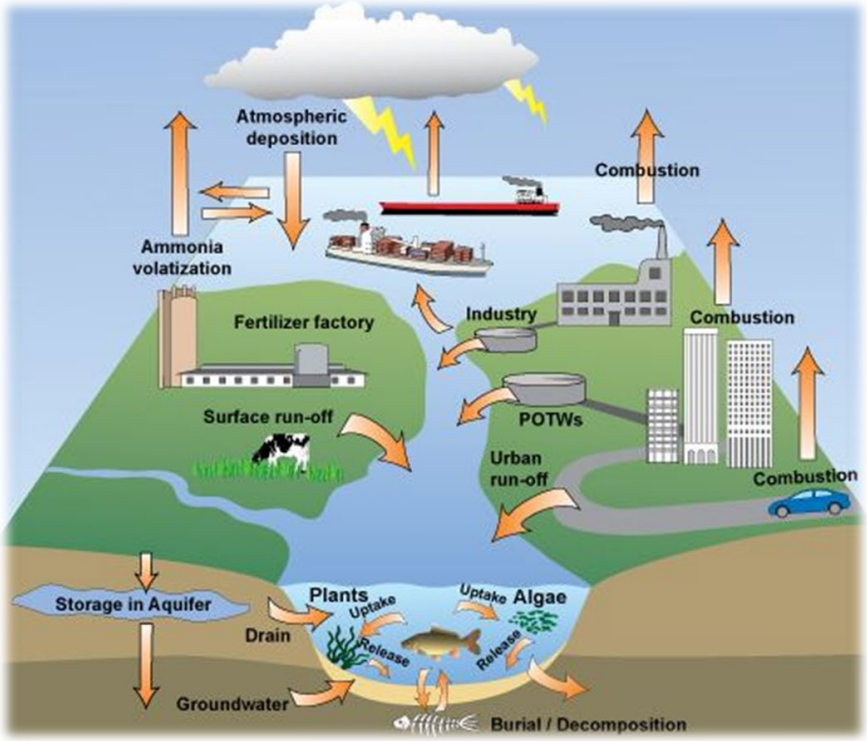
Drought (Drought Monitor, 2022)

Heat (States At Risk, 2022)

Rapidly changing ecology (Bathke et al., 2014)

How nutrients enter water ?

- **Sources:** Nitrogen fertilizers, animal and human waste
- **Regulatory limit:** 10 mg/L as NO_2-N (USA)
- **Greatest exposure**
  - Agricultural areas
  - Private wells
    - Not regulated
    - Sparse measurements



Nebraska Water Quality and Health

Nebraska towns pay millions to fight nitrates as water bills go up

By Jessica Fargen Walsh Special to The World-Herald May 1, 2020 Updated May 1, 2020 4

"If you are a community of 500, this is just devastatingly expensive,"

Citizenship - Water Quality Project

The curriculum design team and consultants came from several school districts, UNL College of Education, UNL College of Engineering, UNMC College of Public Health, and the Nebraska Department of Education.

The purpose of this project is to create an **inquiry-based learning** curriculum that brings attention to the water quality issues in Nebraska and provides outlets for students to **take informed civic action** (NCSS, 2013).

Pedagogy of Inquiry in Science and Social Studies

Identify Issue and Ask Questions

Collect Data, Examine Primary and Secondary Sources

Create An Argument and Establish Reasoning

Take Informed Action

Citizen Science

"Within the CCR-Science standards, opportunities to create civic science connections have been identified. These connections are designed to call-out the importance for students to engage in the study of civic ideals, principles, and practices through participation in the act of "citizen science." Citizen science is the public involvement in inquiry and discovery of new scientific knowledge. This engagement helps students build science knowledge and skills while improving social behavior, increasing student engagement, and strengthening community partnerships. Citizen science projects enlist K-12 students to collect or analyze data for real-world research studies. Citizen science in conjunction with the CCR-Science standards help bridge our K-12 students with stakeholders in the community, both locally and globally" (Nebraska Science Standards, 2017).

Informed Civic Action From Nebraska Social Studies Standards?

"**Investigate** how individuals and groups can effectively use the structure and functions of various levels of government to **shape policy**"

"**Demonstrate** how individuals, groups, and the media **check governmental practices**"

"**Analyze** various media sources for **accuracy** and **perspective**"

"**Engage** and **reflect** on **participation in civic activities**, for example: discussing current issues, influencing governmental actions, participating in civil discourse, registering for selective service, registering to vote, and voting when reaching the age of majority, participating in community improvement activities, service learning"

"**Analyze** the foundation, structures, and functions of **local government** and its outcomes"

"**Investigate an issue** and **communicate** which level of government is most appropriate to utilize **addressing the issue**, for example: students communicate through an editorial, public service announcement, pamphlet, public presentation, tribal council, community entities"

Current Lesson Set

Social Studies Lessons

Lesson 1. Introduction to Water Quality Issues
Lesson 2. Civic Solutions and Project Description
Lesson 3. Researching Nebraska State Senators
Lesson 4. Review Current Legislation
Lesson 5. Nebraska Bill Becomes a Law
Lesson 6. Tracking Influence of Money
Lesson 7. Identify and Interview Stakeholders
Lesson 8. Use Science Data From Student Research to Determine Issues and Solutions
Lesson 9. Examine Historical Trends of Environmental Negligence and Preservations
Lesson 10. Water Quality Through the Lens of Native American Reservation Lands
Lesson 11. Using Geospatial Technology
Lesson 12. Current Native American Struggles for Healthy Water and Water Rights
Lesson 13. Planning for Civic Action
Lesson 14. Present the Informed Action Plan

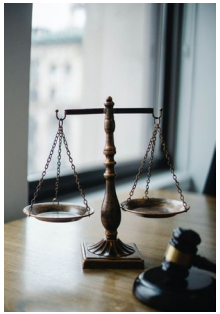
Science

Lesson 1. Description of The Science Project
Lesson 2. Introduction to Maskenthine Lake
Lesson 3. Aquatic Macroinvertebrates
Lesson 4. Algae Blooms
Lesson 5. Physical Geography
Lesson 6. Excess Nutrients in Lakes
Lesson 7. The Tale of Two Reservoirs
Lesson 8. Humans and The Ecosystems
Lesson 9. Urban Waters
Lesson 10. Water Hardness
Lesson 11. Present science data and projects

WHAT ARE STUDENTS DOING?

Develop scientific research skills and analyze data

Read bills and laws that impact the environment



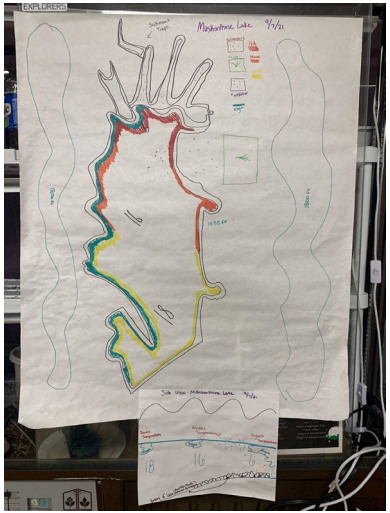
Examine historical trends in environmental preservation and negligence

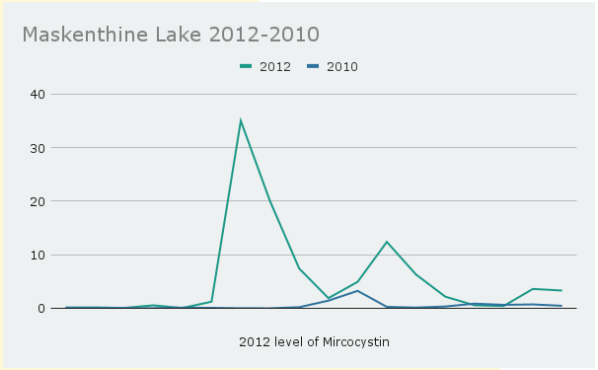
Analyze relevant news reports

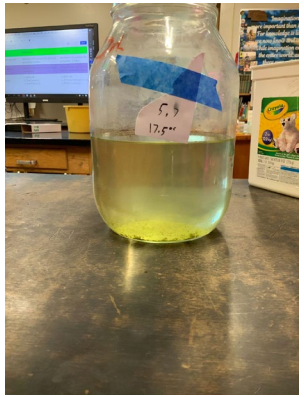
Learn civic skills to enable active citizenship

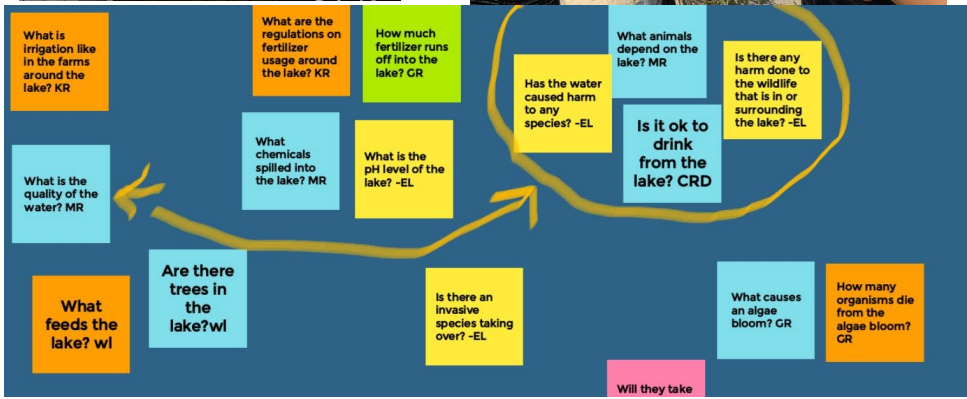
Creation action plans to mitigate or resolve water quality issues in Nebraska

Student Lab Examples

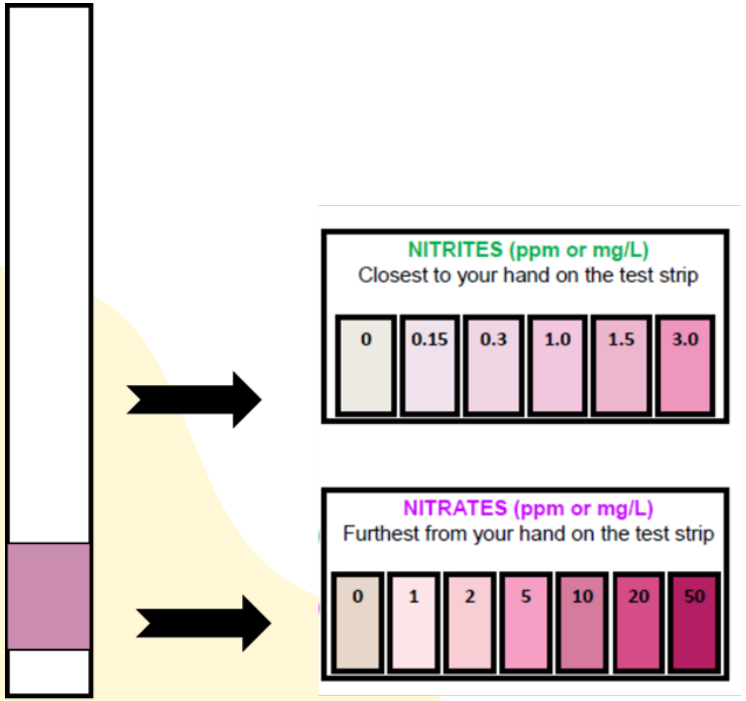








Measuring nutrients in citizen science



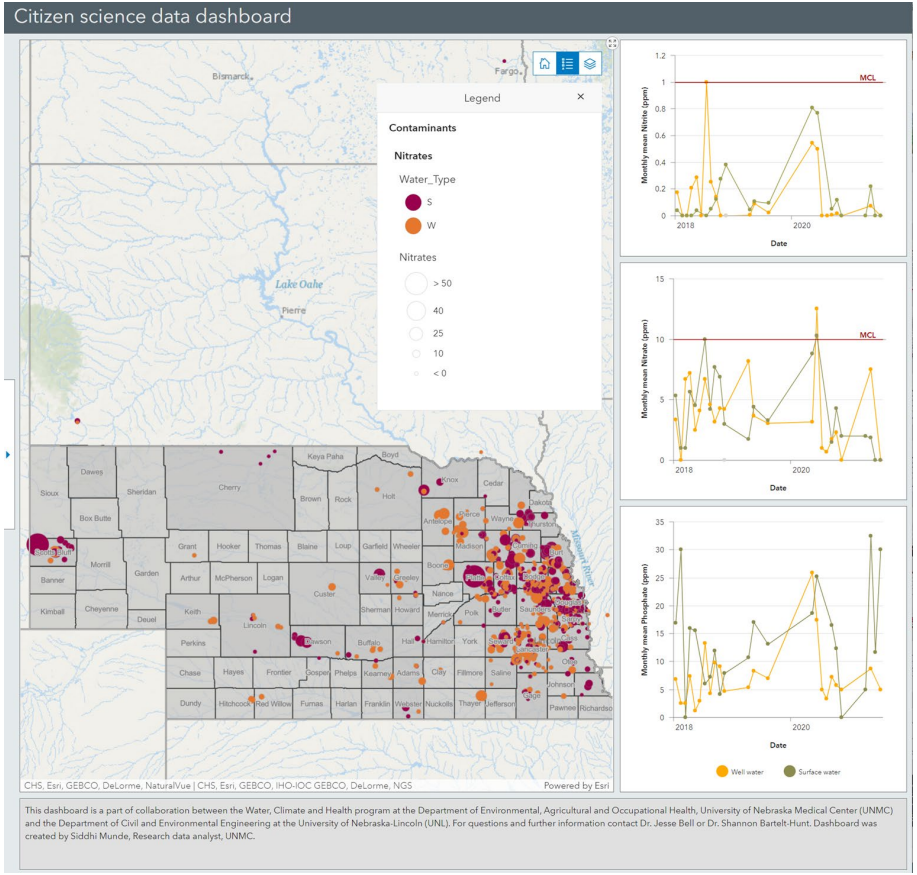
Nitrate and Nitrite:

- Submerge the strip in water for **1** second
- Hold the strip flat for **60** seconds
- Compare the color
- Record your results

Citizen science Data Dashboard

- Data collected for this project since 2018
- Results published through data dashboard
- Map visualization of location of surface and ground water samples
- Size of dots denotes the measurements of respective nutrients
- Graph shows us the monthly pattern of nutrient measurements

Link:
https://urldefense.com/v3/__https:/www.arcgis.com/apps/dashboards/b30336f2ecca4a399c7af35f89e874d8__;!!PvXuogZ4sRB2p-tU!RDupwboDAMP-yFNF5ZQNTh7jD9dAMp6lL6tpbdeXJJKnKt-eOMlfATFkPDg4LxQ$



Nitrate in Nebraska

- High Nitrate concentration in parts of eastern Nebraska.
- Some parts of the state has missing water quality data

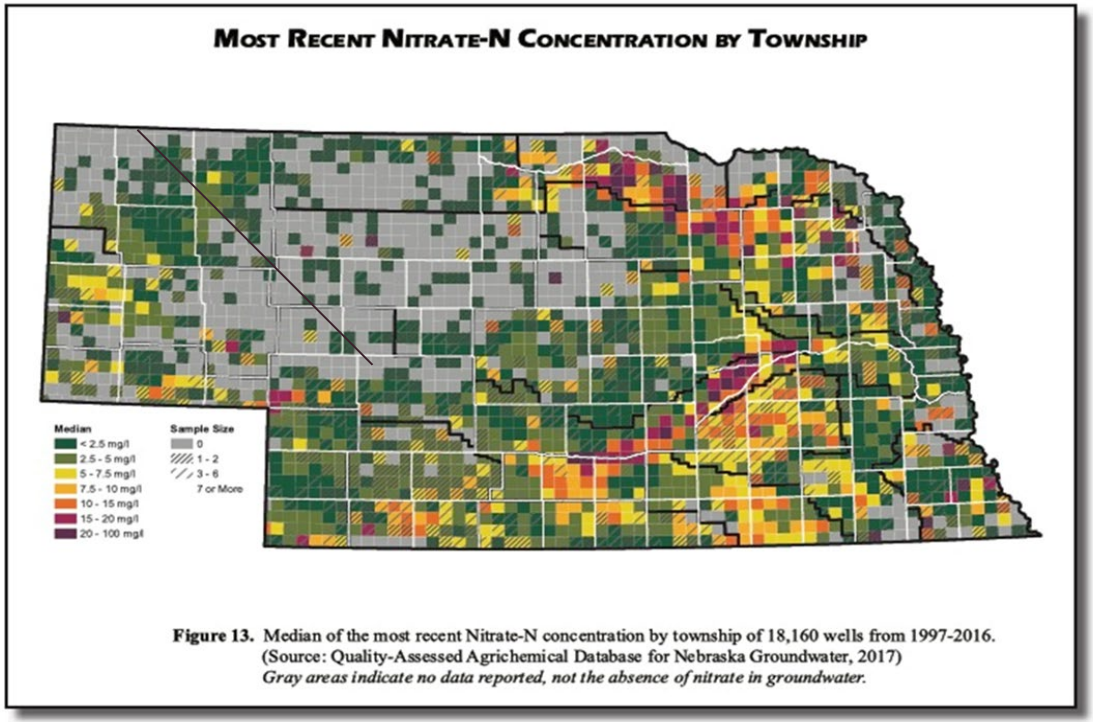
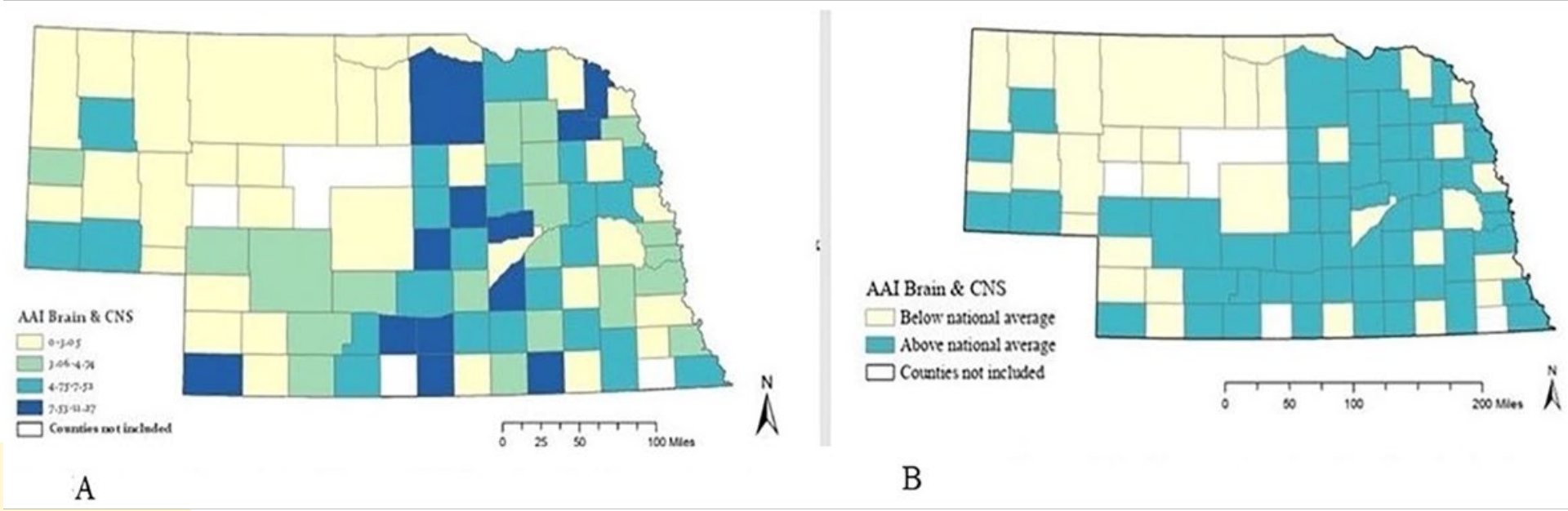


Figure 13. Median of the most recent Nitrate-N concentration by township of 18,160 wells from 1997-2016. (Source: Quality-Assessed Agrichemical Database for Nebraska Groundwater, 2017)
Gray areas indicate no data reported, not the absence of nitrate in groundwater.



(A) Age-adjusted incidence (AAI) of pediatric brain and other CNS cancers per county in Nebraska from 1987 to 2016. (B) Age-adjusted incidence (AAI) of pediatric brain and other CNS cancers in Nebraska counties compared to the national average. Relative to the national average, the age-adjusted incidence of pediatric brain and other CNS cancers is higher in 63% (54/86) of the Nebraska counties.

Nebraska counties where atrazine or nitrate levels were elevated, reported more childhood cancers than counties with lower levels of these chemicals.

GeoHealth, Volume: 6, Issue: 2, First published: 10 February 2022, DOI: (10.1029/2021GH000419)

Civic Actions Students Took

Communicate Conclusions

Students presented findings to one another in a variety of formats. Two teachers created a **mock town hall** that brought together students from science and social studies classrooms.

Critique Arguments

Students completed essays, participated in dialogues, and completed peer assessment. One teacher required students to create **environmental impact surveys** and share.

Critique Explanations

Students participated in **dialogues**. Students were taught to critique reasoning and search for gaps in understanding.

Use Disciplinary Lenses

One teacher focused on **economic principles** to inform students arguments in how they would create sustainable systems.

Plan for Action

Students created **civic action plans** that focused on solving **local issues**. We saw proposals involving urban runoff, rural wastewater, wells in UMÓⁿHOⁿ Nation territory, and town planning.

Take Action

Students **shared their results** with university scientists, Natural Resource Districts, and owners of feedlots and wells. Some students will continue their investigations as senior projects.

Qualitative Multi Case Study

RQI. How do contextual factors influence a teacher's interactions with the *Protecting Nebraska Waters* curriculum?

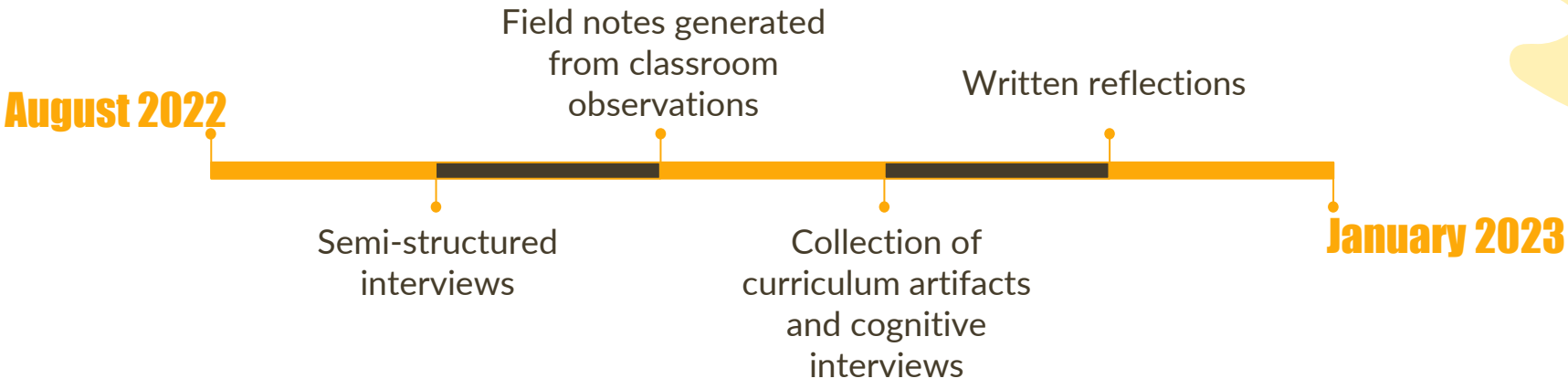
RQII. What obstacles do teachers encounter when piloting the *Protecting Nebraska Waters* curriculum and how do teachers interact with them?

RQIII. What pathways do teachers encounter when piloting the *Protecting Nebraska Waters* curriculum and how do teachers interact with them?

Research Participants

Participants	Gender	Age	Race	Years Teaching	Discipline Taught	Graduate Degree Attainment
001	F	39	White	16	Civics (Dual Credit Government)	Masters in Education (Curriculum and Instruction), Graduate Certificate in Political Science
002	F	47	American Indigenous	20	Tribal Government	Master's in Special Education, Master's in Teaching English as a Second or Foreign Language, and Masters in Elementary Education
003	M	32	White	10	Social Studies	Masters in Education, Pursuing PhD in Education Studies
004	M	36	White	6	Tribal Government	Pursuing Masters of Arts in History
005	M	36	White	14	Social Studies (Geography)	Masters in Geography, Pursuing PhD in Geography Education
006	M	40	White	12	Economics and Environmental Justice	Masters in Education
007	F	48	White	16	Introduction to Agricultural Science and Environmental Science	Masters in Agricultural Science Education
008	F	48	White	22	Science (Earth Science)	Masters of Science Teaching in Earth Science
009	M	53	White	27	Chemistry	PhD in Educational Studies (science focus)
010	F	40	White	13	Environmental Science	Masters in Curriculum and Instruction, Pursuing EdD in Educational Studies

Qualitative Methodology



Research Question 1

How do contextual factors influence a teacher's interactions with the Protecting Nebraska Waters curriculum?

- Each teacher shared a desire for their students to show their community the civic engagement work they were doing, but they shared a deep apprehension of how their local, rural community might react. While teachers shared being proud of their rural identity, they often focused on obstacles that the community presented when thinking about their students being civically engaged.

- ***Claim #1***. Teachers may avoid certain topics because they fear the backlash they might receive. Creating an online house for the curriculum that is highly endorsed may aid in teachers adopting the curriculum.

"We don't want you to attack farmers"

"So I think about some adults saying, okay, your kids aren't doing enough because they're not doing these kinds of [Civic Solution] projects. But on the flip side, I'm like we're going to show you how they can be civically engaged. But, I have a feeling that some adults are going to say, oh but, we wanted to do this other kind of project [one that focused on registering to vote]. We don't want you to attack farmers, so I think the perception of the project is a little bit worrisome."

Research Question 2

What obstacles do teachers encounter when piloting the Protecting Nebraska Waters curriculum and how do teachers interact with them?

"Like a competitiveness"

"With so many responsibilities, Leilah often shared feelings of hopelessness or the inability to help students: "I feel like I still cannot devote enough time to help her," "I don't know when I would have time to do more," and "the problems feel unsurmountable."

- The teachers experienced a competition for their time with other curricula, courses, extracurricular activities, and district contexts when trying to teach a civic engagement curriculum. This competitiveness resulted in lost instructional time towards the piloted curriculum, absent students, and the teachers' general attitudes and emotions of frustration, disappointment, and being overwhelmed

- ***Claim #2***. The obstacles related to school contexts are daunting; individual teachers will unlikely be able to pilot the curriculum to its full potential. Based on this claim, teams of teachers should be recruited and school administration should be consulted to find solutions to time related issues, such as 50-minute class periods.

Research Question 3

What pathways do teachers encounter when piloting the Protecting Nebraska Waters curriculum and how do teachers interact with them?

- The teachers' civic engagement ideology was undergirded by a profound commitment to prepare students to work together to improve future outcomes.

- ***Claim #3***. For curriculum adoption to be successful, professional development should focus on developing teachers' desire to prepare their students for their role as citizens. Preparing students for citizenship may be in tension with school districts' and government focus on standardized test scores

"Us changing things, but for generations"

"Considering that we are a farming community, I wanted to get the kids to care about their home....Not just now, but for generations. And for high school kids, it's always hard to think beyond tomorrow, so I can at least show them this is what's going to happen in ten, twenty, thirty plus years."

If you are going to develop civic engagement . . .

- A teacher typically has 150 hours (180 days, 50 minute periods) to organize curriculum around concepts. We need to have an honest reflection on the learning goals that can be accomplished and how to be efficient with time.

- Assess actual skills in the classroom (ability to communicate, discuss, analyze, work with others). Use language from standards when assessing.

- Online delivery of curriculum assists with absences, truancy, and other teacher involvement.

- “High expectations, high support.”

- An increased amount of class time should be decided to solving problems and receiving more one-on-one assistance from the teacher.

Future Projects and Connection

- Current qualitative research will be completed in May 2023. More cases will be coded and organized during Summer 2023.
- Teachers will add to and revise curricula during Summer 2023. The development team will include teachers from the following disciplines: Agricultural Sciences, Civics, Earth Science, Environmental Science, Language Arts, and Physical Science.
- *Protecting Nebraska Waters* will be piloted and researched during 2023-2024 school year.
- I will apply for additional grants: National Science Foundation's Discovery Grant, Nebraska Environmental Trust, and Library of Congress Teaching with Primary Sources.

Get Involved

- Sign up to test water quality as an individual or class project at go.unl.edu/wqcs. The next testing window will be in **September 2022**
  Contact: Dr. Shannon Bartelt-Hunt,UNL
  sbartelt2@unl.edu

- Collaborations with **Water,Climate and Health Program** at University of Nebraska Medical Center (UNMC)
  Contact: Dr. Jesse E. Bell, UNMC
  jesse.bell@unmc.edu

Citizen Science
WATER QUALITY

University of Nebraska Medical Center

THANKS

Do you have any questions?

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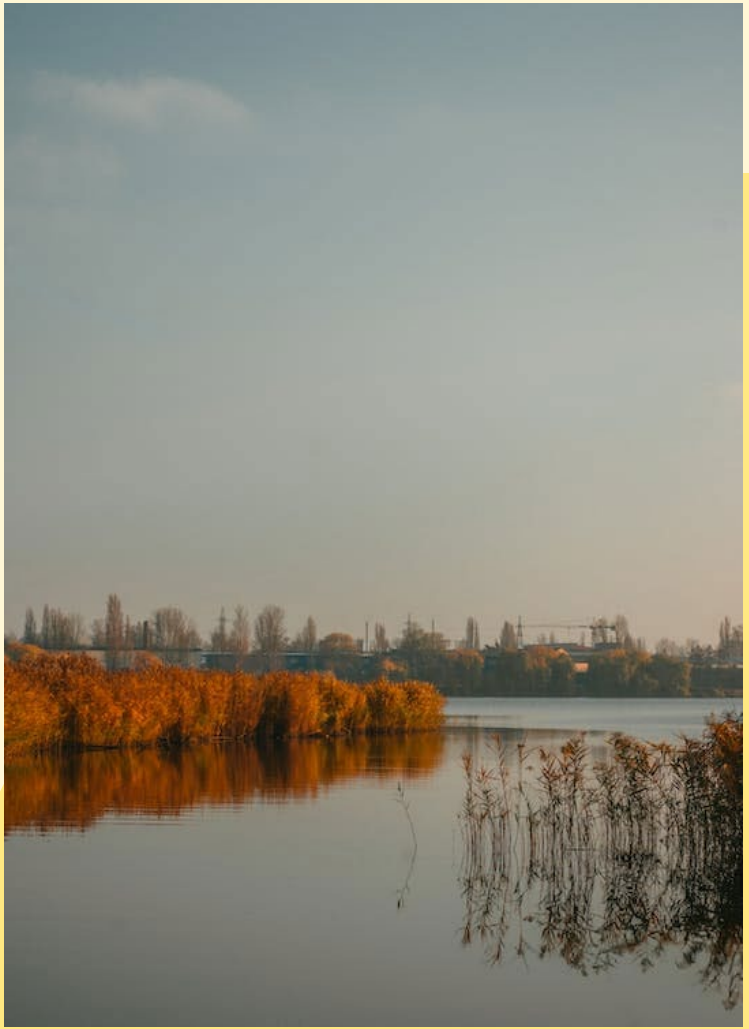

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